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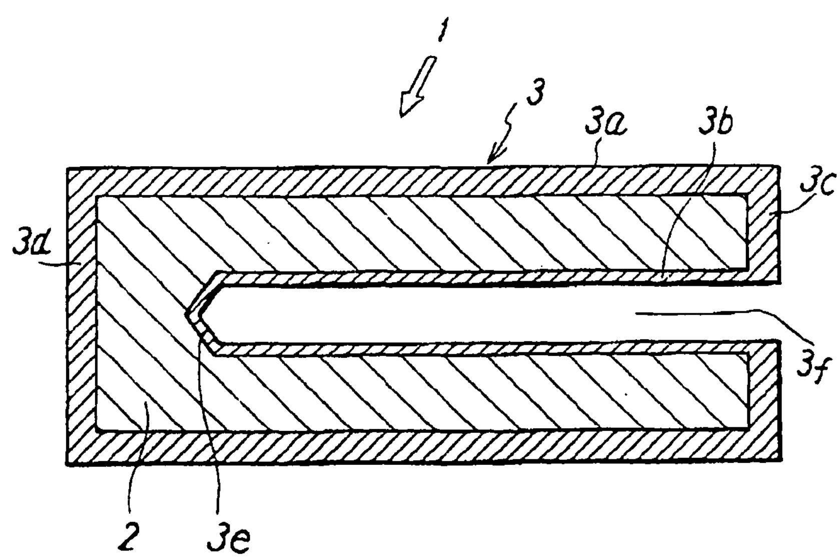
(54) **Fixed-point crucible and fixed-point temperature measuring apparatus and temperature calibration method using the crucible**

(57) A fixed-point crucible 1 comprises a carbon crucible with a fixed-point material of high melting point enclosed in the wall. The fixed-point material is a carbon-metal eutectic. The crucible 1 is disposed in a temperature-variable furnace 6, the temperature of the crucible 1 is increased and decreased by the temperature-variable furnace 6, the temperature of the cavity in the crucible 1 is measured with a thermometer 9 and the thermometer 9 is calibrated from the measured temperature variations. This enables fixed points at temperatures exceeding the melting point of copper to be achieved, thereby allowing highly accurately calibration of a thermometer used in high temperatures such as radiation thermometer, a thermocouple, and the like.

FIG. 1



## Description

[0001] The present invention relates to a fixed-point temperature measuring crucible employed to calibrate a thermometer, for example, a radiation thermometer, a thermocouple and the like used in high temperatures exceeding 1000°C, a fixed-point temperature measuring apparatus and a thermometer calibrating method.

[0002] When thermometers are calibrated, the freezing point or melting point of a metal is employed as a defining fixed-point for temperatures above room temperature. A fixed-point crucible is used to provide the fixed-point temperature.

[0003] Usually the fixed-point crucible is a graphite crucible and the fixed-point material is a pure metal. A thermometer is calibrated by making use of the phenomenon that when the liquid phase and the solid phase of the fixed-point material coexist in the crucible, the temperature of the crucible does not vary due to the latent heat of melting. The method involves placing the fixed-point crucible in a temperature-variable furnace and observing the temperature variation of the crucible when the environmental temperature is increased and decreased (see Chapter 7 of "*New Edition of Proper Use of Thermometer*" edited by Japan Electric Instrument Manufactures' Association and published by Nihon Kogyo Publishing Co. (1997).

[0004] The maximum temperature is the copper point of 1085°C (freezing point of copper), and the temperature scale is defined by extrapolation for temperatures higher than the copper point.

[0005] The temperature scale at temperatures above the copper point is maintained by use of a radiation thermometer calibrated at a fixed point below the copper point or by the radiance temperature corresponding to the current of a strip lamp which uses a tungsten ribbon as a filament.

[0006] To provide a fixed-point temperature above the copper point, attempts have been made to use the freezing point of palladium (freezing point: 1550°C) and platinum (freezing point: 1770°C), and an example where the fixed-point was measured by melting these materials using an alumina crucible has been reported in Quinn, T.J., Chandler T.R.D.: *Temperature, Its Measurement and Control in Science and Industry*, Plumb, H.H. (ed.), Vol. 4, part 1, p.295, Pittsburgh: *Instrument Society of America (1972),* Coates, P.B., Chandler, T.R.D., Andrews, J.W., *High Temperature and High Pressure,* Vol. 15, p. 573 (1983).

[0007] Further, a method comprising using tungsten as the crucible material, melting alumina therein, observing the melting and freezing thereof at 2050°C with a radiation thermometer, and using it as a fixed-point has been reported in Sakate, H., Sakuma, F. Ona, A. *Metrologia,* Vol. 32, p. 129 (1995).

[0008] Thermocouples have been calibrated by a palladium wire method, in addition to the calibration carried out at the copper point (1085°C) or the gold point (1064°C). This is a method of inserting a pure palladium wire in to the distal end of a thermocouple, increasing the temperature of the wire in a heating furnace and observing the temperature plateaus as the wire is melted.

[0009] Metal-metal eutectics have also been tried. It has been reported that a fixed-point temperature was realised by casting copper-silver eutectics or copper-aluminum eutectics in a graphite crucible and observing the melting and freezing thereof (Itoh, *Papers of The Society of Instrumentation and Control Engineers,* Vol. 19, No. 12, p. 978 (1983).

[0010] The maximum temperature of conventional fixed-point crucibles which use graphite and in which pure metal is cast is the copper point of 1085°C. This is because when a metal having a higher melting point is melted in a graphite crucible, the graphite dissolves into the metal and the purity thereof is lowered so that the freezing point drops.

[0011] When a strip lamp or a radiation thermometer is employed because no fixed-point crucible above the copper point is available, since the temperature scale depends on extrapolation, the accuracy is greatly deteriorated. For example, it has been reported that for radiation thermometers in Japan, the accuracy at 1085°C is 0.3°C, but it abruptly deteriorates to 4°C at 1600°C and to 8°C at 2000°C.

[0012] Further, enormous efforts are involved in producing temperature scale of high accuracy through use of a radiation thermometer of high accuracy since an accurate evaluation of the characteristics of the radiation thermometer is required. Moreover, since extrapolation is still required the resulting uncertainty in temperature scale is about 1.2°C at 2000°C.

[0013] On the other hand, with a strip lamp since the emissivity of a strip lamp is not 1, correction is needed depending upon a wavelength to be measured. Thus, not only is it difficult to use the strip lamp with high accuracy but also the strip lamp must be used with an inert gas enclosed therein because the tungsten of the ribbon is evaporated at a temperature above 2000°C. As a result, stable characteristics of the strip lamp cannot be obtained due to the convection of the inert gas.

[0014] Using the palladium point or the platinum point by means of an alumina crucible is possible for a short period. However, the method lacks practicality because a problem arises in that when the alumina crucible is repeatedly used, it breaks. This is because the alumina is susceptible to thermal shock and rendered brittle thereby.

[0015] Sufficient accuracy cannot be obtained in calibration of a thermocouple by the palladium wire method. This is because the reproducibility is only about 1 °C and the interpolation accuracy is low because the copper point is about 500°C away.

[0016] The method of melting alumina in the tungsten crucible is scarcely used. This is because the processability of tungsten is bad, it is difficult to enclose molten alumina in a lateral crucible and sufficient accuracy can-

not be obtained since a blackbody cavity whose emissivity is near to 1 cannot be formed due to the low emissivity of the tungsten.

[0017] The method of using metal/metal eutectics allows an increase in the number of fixed-point temperatures lower than the copper point. However, when the same method is used at temperatures higher than the copper point, a fixed-point temperature cannot be realised because the freezing point is inevitably lowered by dissolving of graphite.

[0018] It is an object of the present invention to overcome the problems of known methods and to provide fixed-point temperatures exceeding the copper point, to enhance calibration accuracy of all thermometers used in a high temperature region such as a radiation thermometer, a thermocouple and the like.

[0019] A fixed-point crucible of the present invention comprises a crucible composed of carbon and having a blackbody cavity or a thermometer well formed therein, and a fixed-point material of high melting point enclosed in the wall of the crucible, wherein the fixed-point material is a eutectic of carbon and metal.

[0020] Iron, cobalt, nickel, palladium, rhodium, platinum, ruthenium, iridium, rhenium and osmium are suitable metals for the fixed-point crucible.

[0021] A fixed-point temperature measuring apparatus of the present invention has the fixed-point crucible located in a temperature-variable furnace with the temperature-variable furnace including a heating device for increasing and decreasing the environmental temperature of the crucible and a temperature measuring means capable of measuring the temperature variation of the cavity in the crucible through a thermometer.

[0022] More specifically, the fixed-point temperature measuring apparatus may use an electric furnace as the temperature-variable furnace, the fixed-point temperature measuring crucible being accommodated in the electric furnace. The electric furnace may include a heating device comprising a tubular heater which is heated by electrical current flow, a heat insulator for covering the heater and an air tight casing for covering both. The casing may include a vacuum suction means for evacuating the interior of the furnace and an inert gas supply means.

[0023] As the tubular heater, a graphite furnace core tube, which is heated by direct current flow, many be used, or a heater element which surrounds an alumina furnace core tube and in which the fixed-point crucible is loaded, may be used.

[0024] The temperature measuring means may comprise a quartz glass sight hole for calibrating a radiation thermometer disposed at a position where the blackbody cavity of the crucible can be observed, or a thermometer inserted in alumina protective tube, which reaches the interior of the thermometer well of the crucible from the outside of the casing.

[0025] The temperature-variable furnace may be provided with a monitor thermometer for controlling heater power.

[0026] A thermometer calibrating method of the present invention comprises the steps of disposing in a furnace a carbon fixed-point crucible having a fixed-point material of high melting point enclosed in the wall thereof, the fixed-point material being a eutectic of carbon and a metal, melting and freezing the fixed-point material by heating it in the furnace, measuring the temperature variation of the fixed-point material with a thermometer to be calibrated, and calibrating the thermometer based on observed plateaus.

[0027] The method is particularly suitable for calibration of a radiation thermometer, a thermocouple and a resistance thermometer but other types of thermometer can also be calibrated thereby.

[0028] Since the fixed-point crucible uses a eutectic of carbon and a metal as a fixed-point material, the temperature scale at high temperatures can be accurately realized, whereas sufficient accuracy cannot conventionally be obtained because it depends on extrapolation from the copper point of 1085°C.

[0029] The fixed-point temperature measuring apparatus and the temperature calibrating method of the present invention allow high fixed-point temperatures to be measured and thermometers such as a radiation thermometer, a thermocouple, a resistance thermometer and the like to be calibrated by interpolation with the result that accuracy can be greatly improved.

[0030] The temperature scale can be maintained by using only fixed-points and a radiation thermometer without the use of a standard strip lamp which is conventionally used to maintain the temperature graduation.

[0031] Further, since calibration can be carried out by interpolation, the accurate evaluation of the characteristics of a highly-accurate standard radiation thermometer, which is conventionally required, is unnecessary, whereby calibration is remarkably simplified and the system for providing a temperature scale is greatly improved.

[0032] Furthermore, the palladium wire method is unnecessary for the calibration of a thermocouple. In addition, in the development of a high temperature thermocouple, the characteristics of the thermocouple such as the stability, the variation among different thermocouples and the like can be evaluated with high accuracy, which can also contributed to the improvement of the characteristics of the thermocouple.

[0033] The invention will now be described by way of example and with reference to the accompanying drawings in which:

[0034] Fig. 1 is a sectional view showing an embodiment of a fixed-point temperature measuring crucible according to the present invention.

[0035] Fig. 2 is a view showing the fixed point temperatures of metal-carbon eutectics used in the present invention and a conventionally used pure metal.

[0036] Fig. 3 is the nickel-carbon binary alloy phase

diagram provided as an example of the metal-carbon eutectics used according to the present invention.

[0037] Fig. 4 is a sectional view showing an embodiment of a fixed-point temperature measuring apparatus according to the present invention.

[0038] Fig. 5 shows an example of an output from a thermometer to be calibrated with the apparatus of Fig. 4.

[0039] Fig. 6 is a sectional view showing another embodiment of the fixed-point temperature measuring apparatus according to the present invention.

[0040] Fig. 7 shows an example of an output from a thermometer to be calibrated with the apparatus of Fig. 6.

[0041] Fig. 1 is a sectional view showing an embodiment of a fixed-point crucible 1 composed of a graphite crucible 3 and an eutectic structure of carbon and metal 2 enclosed in the wall of the crucible 3 which uses the temperature of the melting point and the freezing point of the eutectic structure of carbon and metal 2 as a fixed-point temperature.

[0042] To describe the fixed-point crucible in more detail, the wall of the graphite crucible 3 has a hollow double-walled cylindrical shape concentrically including an outer cylinder 3a and an inner cylinder 3b. The outer cylinder 3a and the inner cylinder 3b are coupled with each other at ends thereof through an end wall 3c, and the other ends of the outer cylinder 3a and the inner cylinder 3b are closed with end walls 3d and 3e disposed at intervals respectively.

[0043] The eutectic structure of carbon and pure metal 2 as a fixed-point material is cast and enclosed in the spaces between the outer cylinder 3a and the inner cylinder 3b and between the end wall 3d and the end wall 3e. Then, the interior of the inner cylinder 3b is arranged as a fixed-point temperature measuring blackbody cavity or thermometer well 3f.

[0044] A thermometer is calibrated by disposing the crucible 1 in a temperature-variable electric furnace, observing the temperature variation in the fixed-point crucible 1 with the thermometer when the environmental temperature is increased and decreased and making use of the phenomenon that the temperature variation due to latent heat of melting disappears when the eutectic structure 2 in the fixed-point crucible 1 coexists as a liquid phase and a solid phase as described below.

[0045] Various types of thermometers to be used at high temperatures such as a radiation thermometer, a thermocouple, a resistance thermometer and the like can be used as the thermometer to be calibrated.

[0046] Suitable metal materials for the eutectic structure of carbon and metal 2 of the fixed-point crucible 1 are those which form carbon eutectics whose melting point is higher than the copper point. Specifically, iron, cobalt, nickel, palladium, rhodium, platinum, ruthenium, iridium, rhenium, and osmium are suitable as the metal material.

[0047] Next, the operation of the fixed-point crucible of the present invention will be described with reference to Fig. 2 and Fig. 3 which show the fixed-point temperature of metal-carbon eutectics used in the present invention and a conventionally used pure metal fixed-point temperature, and a nickel-carbon binary alloy phase diagram as an example.

[0048] While the freezing point of pure nickel is 1455°C, it can be found from the figures that a eutectic in a composition ratio containing 3.0 wt% of carbon has a fixed-point temperature at 1326.5°C.

[0049] When the nickel-carbon eutectic composed of nickel to which 3.0 wt% of carbon is added is used as a fixed-point material, if the nickel-carbon eutectic is heated and the temperature thereof exceeds its melting point, graphite as a crucible material is slightly dissolved into the eutectic metal. However, when the temperature of the nickel-carbon eutectic is decreased again, the composition ratio of the eutectic is recovered when the freezing-point is reached because excessive graphite is precipitated. As a result, melting and freezing plateaus of good reproducibility can be observed.

[0050] Since the eutectic is composed of graphite, which is the crucible material, and pure-metal, the crucible material is intrinsically free from impurities from the crucible, thus the freezing point does not drop. Further, since graphite is used, the problem of the durability of a crucible, which is arisen when an alumina crucible is used, is not caused. Furthermore, when the nickel-carbon eutectic, to which carbon was previously added, is melted at the eutectic composition ratio thereof, graphite is dissolved from the crucible only in a slight amount and the durability of the crucible is not deteriorated by the melt of the crucible.

[0051] Further, since graphite having high emissivity is used as the crucible material, the blackbody cavity 3f having sufficiently high emissivity can be easily formed and the cavity 3f is also suitable for the calibration of a radiation thermometer.

[0052] Since a thermometer calibrated at the fixed-point temperatures shown in Fig. 2 is calibrated by interpolation up to a high temperature region of 2732°C, the calibration accuracy thereof can be greatly improved. Further, even if the thermometer is calibrated by extrapolation using any of the fixed-point temperatures, extrapolation accuracy can be greatly improved as compared with a conventional method because the calibration is carried out at a temperature higher than the copper point.

[0053] Fig. 4 shows an embodiment of a fixed-point temperature measuring apparatus using the fixed-point temperature measuring crucible 1 and Fig. 5 shows an example of an output from a thermometer calibrated with the apparatus of Fig. 4.

[0054] In the fixed-point temperature measuring apparatus of the embodiment of Fig. 4, the fixed-point temperature measuring crucible 1 is disposed in a temperature-variable electric furnace 4, which is provided with a heating device for increasing and decreasing the en-

vironmental temperature of the crucible 1 and further with a temperature measuring means capable of measuring the temperature variation of the blackbody cavity 3f in the crucible with a thermometer. In the fixed-point temperature measuring crucible a ruthenium-carbon eutectic structure composed of, for example, ruthenium to which 1.2 wt% of carbon is added can be used as the fixed-point material.

**[0055]** The temperature-variable electric furnace 4 accommodates the fixed-point crucible 1 therein and includes a tubular heater, which is formed of a graphite furnace core tube 5 which is heated by direct current flow, a heat insulator 7 for covering it and an air tight casing 6 for accommodating them. The casing 6 is provided with a vacuum suction means 30 composed of a vacuum pump for evacuating the interior of the furnace to vacuum and an inert gas supply means 31 composed of a piping connected to a gas supply source. Then, after the interior of the temperature-variable electric furnace 4 is evacuated to vacuum as a whole, the interior thereof is set to an inert gas atmosphere and the temperature of the furnace is measured.

**[0056]** The casing 6 includes a cylindrical casing main body 6a and lid portions 6b and 6b' for covering both the ends of the casing main body 6a. Further, the casing 6 is provided with a quartz glass sight hole 6c for calibrating a radiation thermometer 9. The quartz glass sight hole 6c acts as a temperature measuring means for measuring the temperature of the blackbody cavity 3f with the radiation thermometer to be calibrated and is located at the centre of the lid portion 6b a position where the blackbody cavity 3f of the crucible 1 can be observed. Further, a quartz glass sight hole 6c' is also disposed to the other lid portion 6b' and a monitor radiation thermometer 10 is disposed externally of the quartz glass sight hole 6c' to control the energization of the heater. The quartz glass sight holes 6c and 6c' may be merely sight holes.

**[0057]** The radiation thermometer 9 to be calibrated measures the temperature of the fixed-point crucible by detecting the light radiated from the blackbody cavity 3f of the fixed-point crucible 1 through the quartz glass sight hole 6c. Further, the monitor radiation thermometer 10 monitors the temperature of the interior of the electric furnace 4 and controls the power by inputting the signal output from the monitor radiation thermometer 10 to the controller of a heater heating current.

**[0058]** Further a heat insulator 8 is inserted around the fixed-point crucible 1 for the purpose of increasing the uniformity of a temperature distribution and improving the electrical insulation between the graphite furnace core tube 5 and the fixed-point crucible 1.

**[0059]** The output from the radiation thermometer 9 is shown in Fig. 5. Melting and freezing plateaus can be observed, from which the thermometer can be calibrated at the fixed-point temperature.

**[0060]** Fig. 6 and Fig. 7 shows another embodiment of a fixed-point temperature measuring apparatus using the fixed-point crucible according to the present invention.

**[0061]** The fixed-point crucible 1 used in the embodiment shown in Fig. 6 is similar to the fixed-point crucible shown in Fig. 1. However, nickel-carbon eutectic composed of, for example, nickel to which 3.0 wt% of carbon is added can be used by being cast as a fixed-point material in the graphite crucible 1.

**[0062]** In the fixed-point temperature measuring apparatus of the embodiment, the fixed-point crucible 1 is loaded in a vertical temperature-variable electric furnace 14. The electric furnace 14 includes an alumina furnace core tube 15 in which the fixed-point crucible 1 is loaded, a heater element 16 which is disposed so as to surround the alumina furnace core tube 15 and heated by electrical current flow, a heat insulator 17 for further surrounding the heater element 16 and a casing 18 for accommodating them.

**[0063]** The casing 18 is composed of a cylindrical casing main body 18a and lid portions 18b and 18b' disposed so as to cover both the ends of the casing main body 18a. The alumina furnace core tube 15 is inserted into the casing 18 through the lid portion 18b.

**[0064]** The alumina furnace core tube 15 has a cylindrical shape with its inner end closed and its outer end is covered with a lid member 15a having a small opening located at the centre thereof. Then, a thermometer inserting alumina protective tube 19 is disposed as a temperature measuring means for measuring the temperature of a cavity 3f of the crucible 1 with a thermometer to be calibrated. The alumina protective tube 19 reaches the interior of the blackbody thermometer well 3f from the outside of the casing 18 through the small opening of the lid member 15a. A thermocouple 20 to be calibrated can be inserted into the alumina protective tube 19.

**[0065]** The furnace 14 is provided with a vacuum suction means 30 composed of a suction pump for evacuating the interior of the furnace core tube 15 to vacuum and an inert gas supply means 31 composed of a piping connected to a gas supply source, similarly to the embodiment of Fig. 4. Then, after the interior of the furnace tube 15 is evacuated to vacuum as a whole, the interior thereof is set to an inert gas atmosphere and the temperature of the furnace is measured.

**[0066]** Further, an alumina protective tube 19' is inserted into the temperature variable electric furnace 14 from under the furnace 14 through the lid portion 18b'. A monitor thermocouple 21 for controlling the energization of the heater element is inserted into the alumina protective tube 19'. Then, the furnace temperature of the temperature variable electric furnace 14 is monitored with the monitor thermocouple 21, the signal output from the monitor thermocouple 21 is supplied to the controller of the heater element 16 so that the furnace temperature of the temperature-variable electric furnace 14 is controlled by controlling a current supplied to the heater element 16.

**[0067]** Note that the heater element 16 is separately

controlled in the three zones thereof divided into an upper zone, an intermediate zone and a lower zone to increase the uniformity of the temperature distribution around the fixed-point temperature measuring crucible.

**[0068]** The casing 6 and furnace tube 15 in the embodiment shown in Figs. 4 and 6 respectively are formed air tight, however these do not have to be necessarily air tight, and the vacuum suction means 30 for evacuating the interior of the furnace to vacuum is not necessarily needed.

**[0069]** Fig. 7 shows the output from the thermocouple 20. Melting and freezing plateaus can be observed, from which the thermocouple 20 can be calibrated at the fixed-point temperature.

**[0070]** As will be apparent from the above, the thermometer calibrating method carried out by the fixed-point temperature measuring apparatuses of the above respective embodiments is such that the fixed-point temperature measuring crucible, whose fixed-point material is a eutectic structure of carbon and metal, is placed in the temperature-variable furnace, the fixed-point material of high melting point is melted and frozen by being heated by the furnace as shown in Fig. 5 and 7, the temperature variation of the fixed-point material is measured with the thermometer to be calibrated and the thermometer is calibrated based on observed plateaus.

**[0071]** While the present invention has been described with reference to the above embodiments, the present invention is by no means limited to the above embodiments. While thermometers to be calibrated are, for example, the radiation thermometer, the thermocouple and the resistance thermometer as described above, they are not limited thereto and any thermometers can be calibrated so long as they are used in a high temperature region and, for example, a fibre-optic thermometer and the like can be also calibrated by the present invention.

## Claims

1. A fixed-point crucible comprising a carbon crucible having a cavity formed therein and a fixed-point material of high melting point enclosed in the crucible wall, wherein the fixed-point material is a eutectic of carbon and a metal.

2. A fixed-point crucible as claimed in Claim 1, wherein the metal is any of iron, cobalt, nickel, palladium, rhodium, platinum, ruthenium, iridium, rhenium, and osmium.

3. A fixed-point temperature measuring apparatus, comprising a temperature-variable furnace having a fixed-point crucible as claimed in either Claim 1 or Claim 2 located therein, wherein the temperature-variable furnace includes a heating device for increasing and decreasing the environmental temperature of the crucible and temperature measuring means for measuring the temperature variation of the crucible cavity comprising a thermometer.

4. A fixed-point temperature measuring apparatus as claimed in Claim 3, wherein the thermometer is a radiation thermometer, a thermocouple or a resistance thermometer.

5. A fixed-point temperature measuring apparatus as claimed in either Claim 3 or Claim 4, wherein the temperature-variable furnace is an electric furnace, which includes a heat insulator for covering the heating device and a casing for covering the heating device and heat insulator, and wherein the casing includes means for supplying inert gas to the interior of the furnace.

6. A fixed-point temperature measuring apparatus as claimed in Claim 5, wherein the thermometer is inserted in an alumina protective tube which extends from the interior of the crucible cavity to the exterior of the casing.

7. A fixed-point temperature measuring apparatus as claimed in any one of Claims 3 to 5, wherein the temperature measuring means includes a sight hole for calibrating a radiation thermometer disposed at a position where the cavity of the crucible can be observed.

8. A fixed-point temperature measuring apparatus as claimed in any one of Claims 3 to 7, wherein the heating device is tubular and comprises a graphite furnace core tube which is heated by direct current flow.

9. A fixed-point temperature measuring apparatus as claimed in any one of Claims 3 to 7, wherein the heating device is tubular and comprises a alumina furnace core tube in which the fixed-point crucible is loaded and a surrounding heater element.

10. A thermometer calibrating method comprising providing a fixed-point crucible formed of carbon and having a fixed-point material of high melting point enclosed in the wall thereof the fixed-point material being a eutectic of carbon and a metal, melting and freezing the fixed-point material by heating the crucible in a furnace, measuring the temperature variation of the fixed-point material with a thermometer to be calibrated, and calibrating the thermometer based on observed plateaus.

FIG. 1

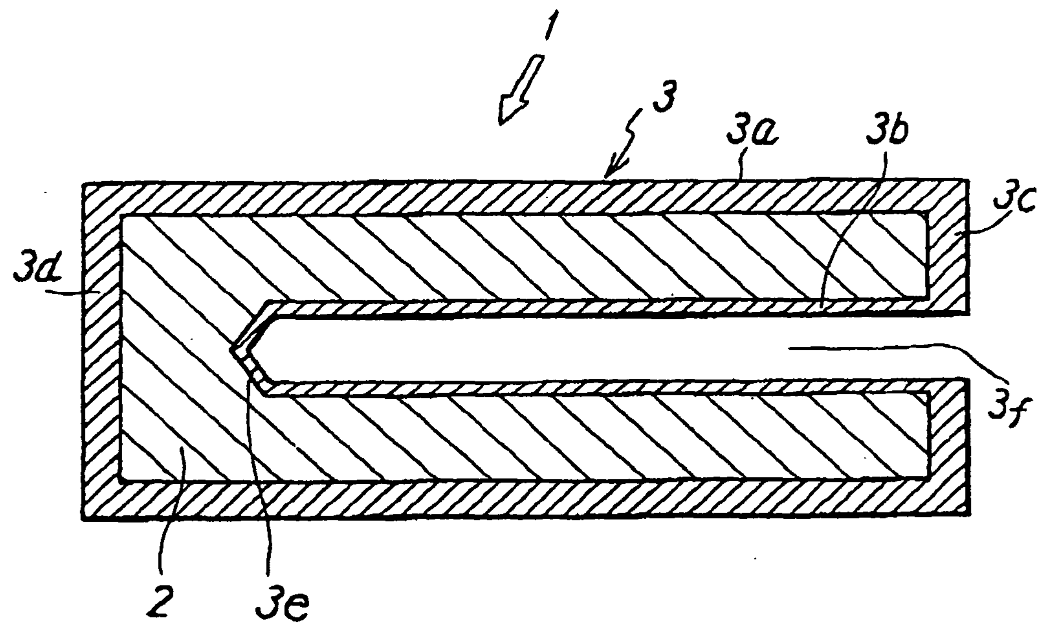
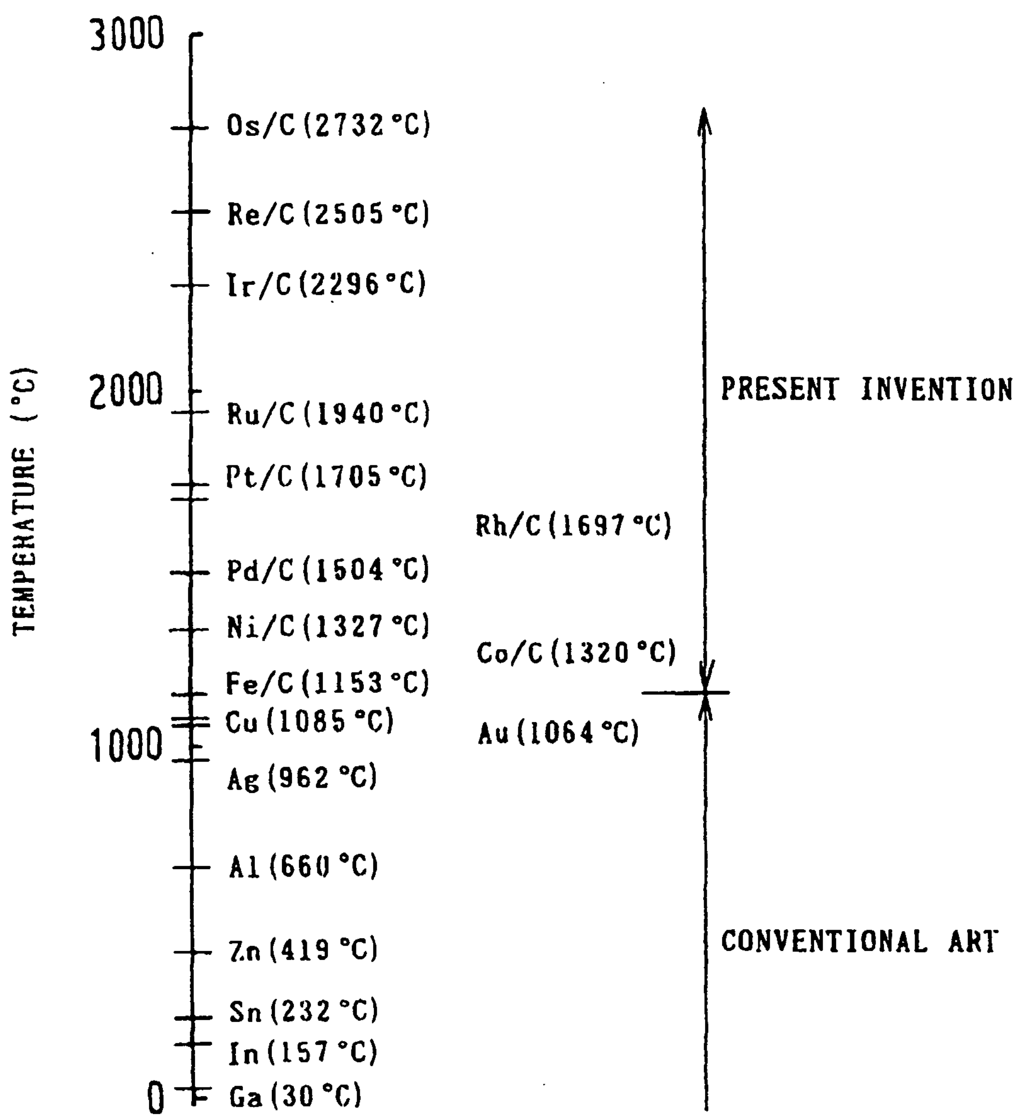


FIG. 2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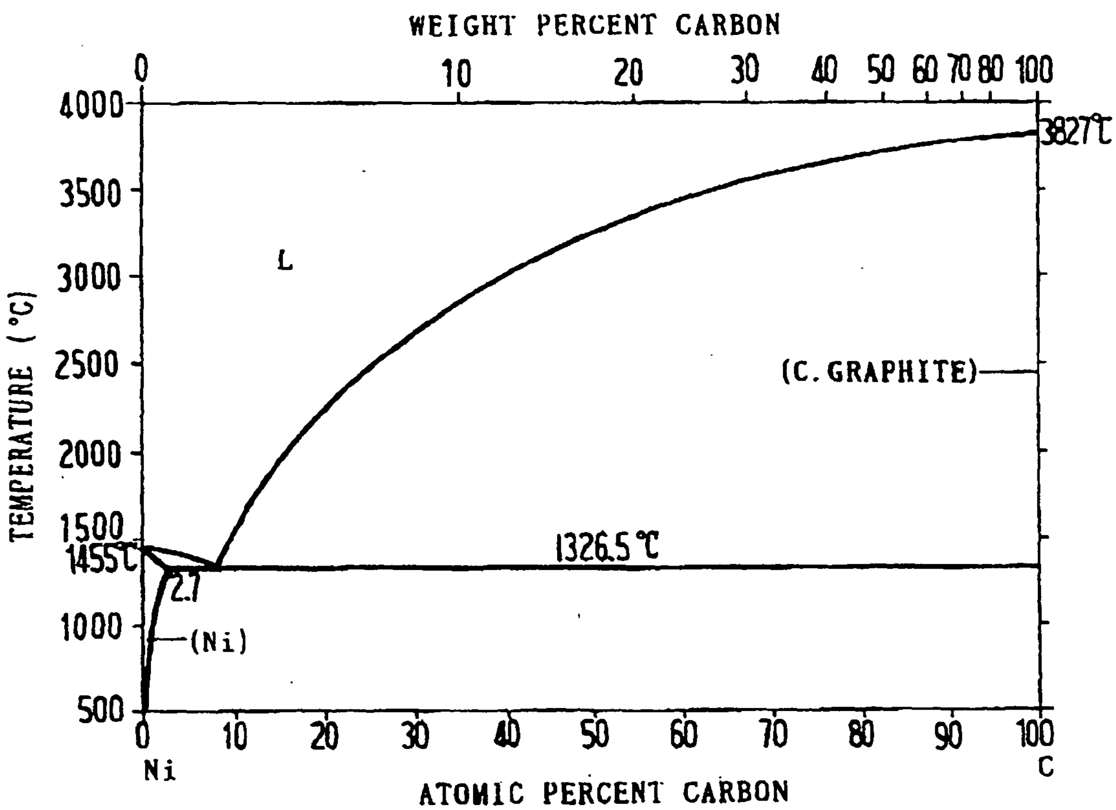
PRESENT INVENTION
CONVENTIONAL ART

FIG. 3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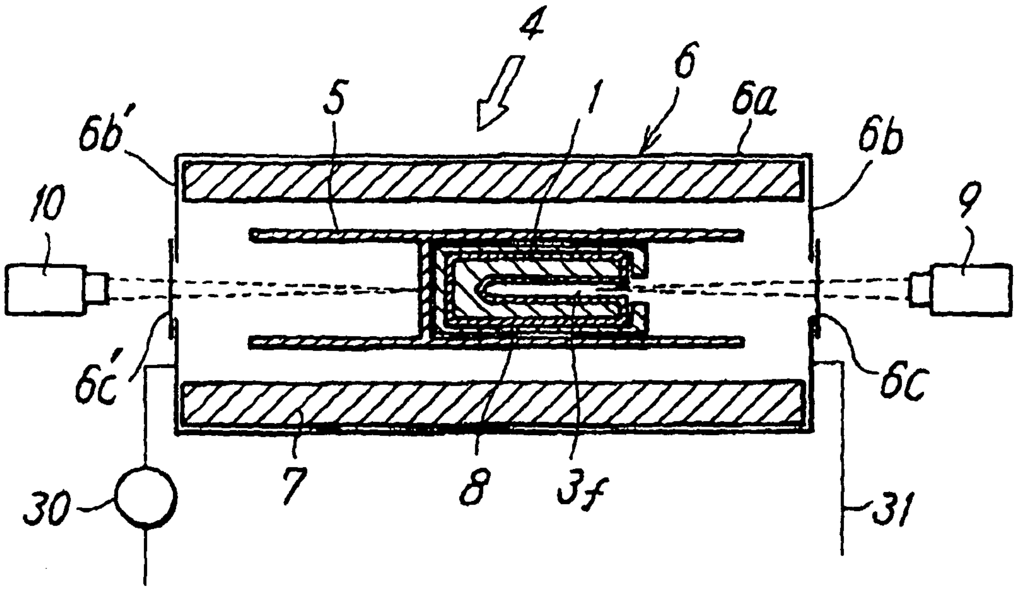
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FIG. 5

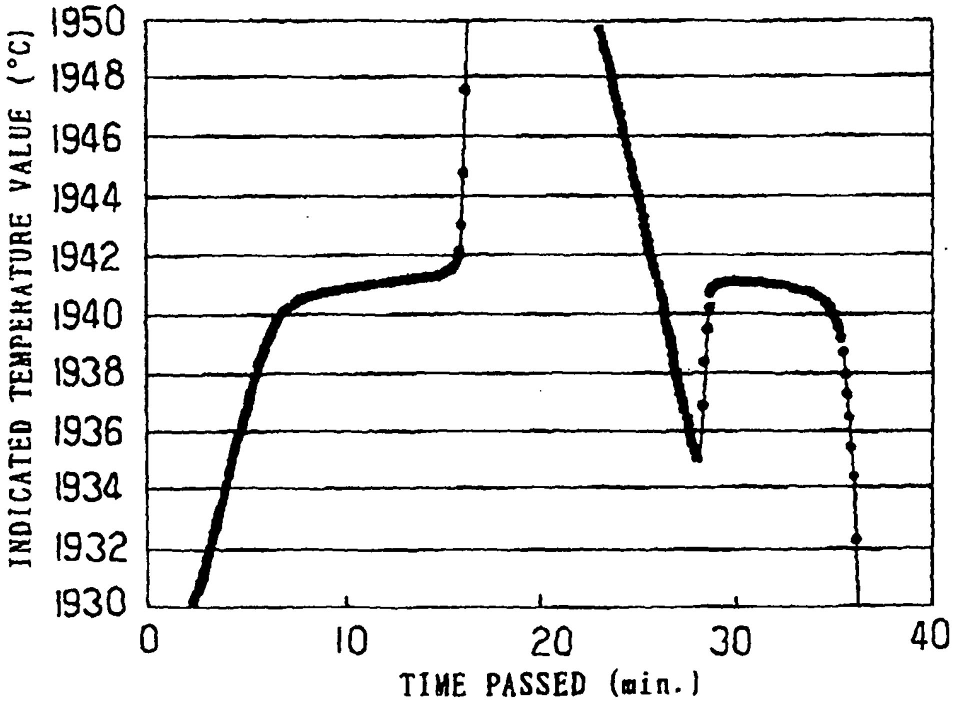
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FIG. 6

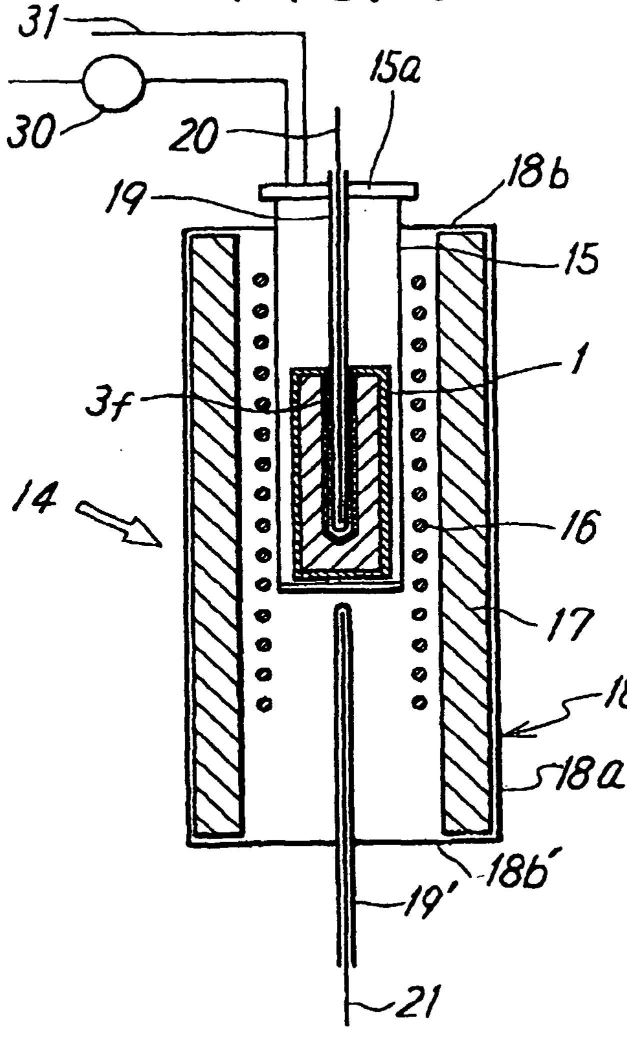
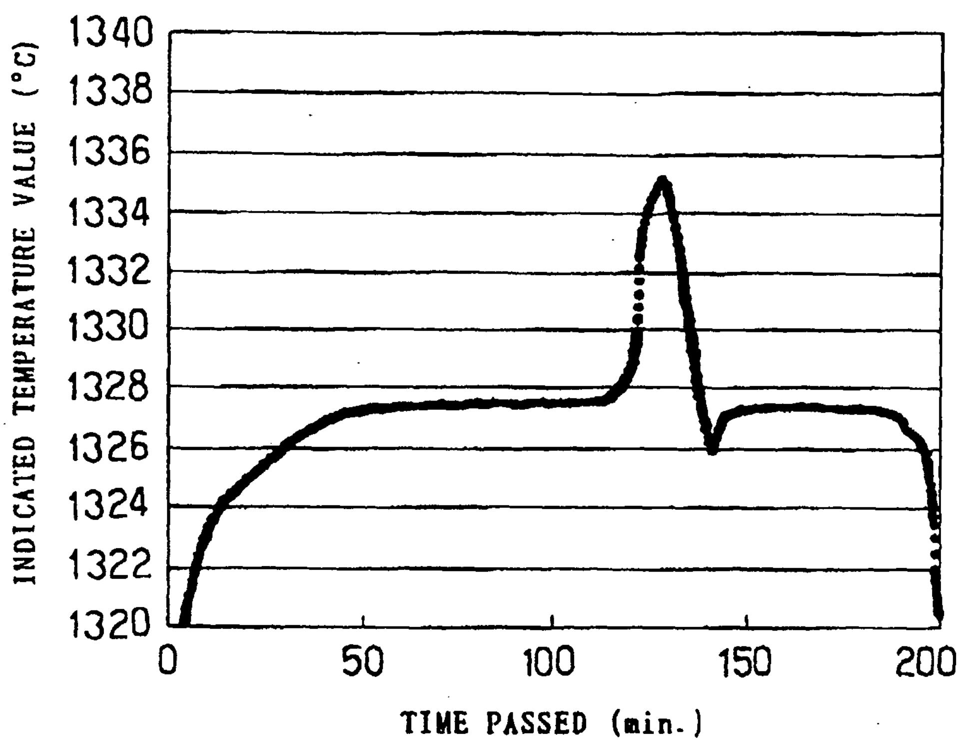


FIG. 7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European Patent Office
Office européen des brevets

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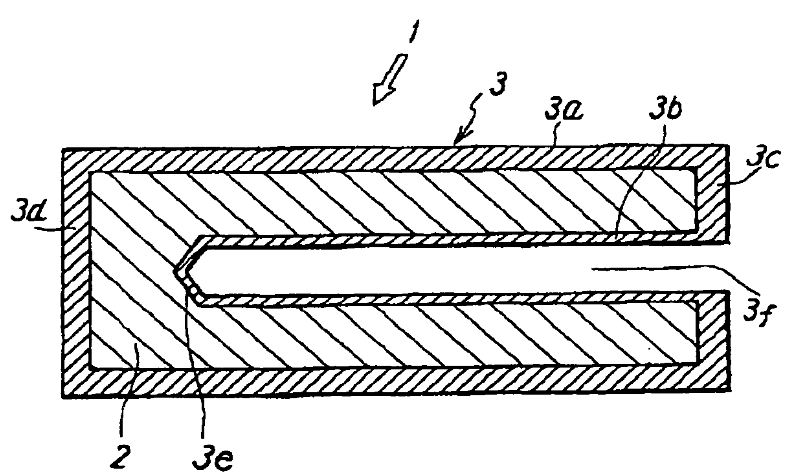
# (54) Fixed-point crucible and fixed-point temperature measuring apparatus and temperature calibration method using the crucible

(57) A fixed-point crucible 1 comprises a carbon crucible with a fixed-point material of high melting point enclosed in the wall. The fixed-point material is a carbon-metal eutectic. The crucible 1 is disposed in a temperature-variable furnace 6, the temperature of the crucible 1 is increased and decreased by the temperature-variable furnace 6, the temperature of the cavity in the crucible 1 is measured with a thermometer 9 and the thermometer 9 is calibrated from the measured temperature variations. This enables fixed points at temperatures exceeding the melting point of copper to be achieved, thereby allowing highly accurately calibration of a thermometer used in high temperatures such as radiation thermometer, a thermocouple, and the like.

FIG. 1

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# EUROPEAN SEARCH REPORT

Application Number
EP 99 30 9974

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The present search report has been drawn up for all claims

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